The Role of Narrative in the Development of Children's Pain Memories:

Influences of Father- and Mother-Child Reminiscing on Children's Recall of Pain

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Disclosures: The authors have no conflicts of interest to declare.

Funding: This work was supported by the Society of Pediatric Psychology Targeted Research Grant, American Pain Society Future Leader in Pain Grant, Maternal Newborn Child and Youth Strategic Clinical Network Health Outcomes Improvement Fund, University of Calgary Faculty of Science Seed Grant as well as start up funding from the Alberta Children's Hospital Research Institute awarded to Noel. Pavlova was supported by the Alberta Strategy for Patient-Oriented Research Graduate Studentship. Graham's contributions were supported by funding through the Alberta Children's Hospital Foundation.

Abstract

Negatively biased memories for pain (i.e., recalled pain is higher than initial report) robustly predict future pain experiences. During early childhood, parent-child reminiscing has been posited as playing a critical role in how children's memories are constructed and reconstructed; however, this has not been empirically demonstrated. This study examined the role of parent-child reminiscing about a recent painful surgery in young children's pain memory development. Participants included 112 children (M_{age}=5.3 years; 60% boys) who underwent a tonsillectomy and one of their parents (34% fathers). Pain was assessed in hospital and during the recovery phase at home. Two weeks post-surgery, parents and children attended a lab visit to participate in a structured narrative elicitation task wherein they reminisced about the surgery. Four weeks post-surgery, children completed an established pain memory interview using the same previously administered scales via telephone. Narratives were coded for style (elaboration) and content (pain, emotion) based on coding schemes drawn from the developmental psychology literature. Findings revealed that a more elaborative parental reminiscing style in addition to greater use of emotional words predicted more accurate/positively biased pain memories. Greater parental use of pain words predicted more negatively biased pain memories. Although there were no sex and parent-role differences in pain memory biases, mothers and fathers differed in how they reminisced with their boys versus girls. This research underscores the importance of parent-child reminiscing in children's pain memory development and may be used to inform the development of a parent-led memory reframing intervention to improve pediatric pain management.

The Role of Narrative in the Development of Children's Pain Memories: Influences of Father- and Mother-Child Reminiscing on Children's Recall of Pain

Children's memory for pain is a robust predictor of future pain experience [31]. Across clinical and experimental settings, healthy and illness populations, and early childhood and adolescence, it has been demonstrated that children who develop negatively biased memories of pain (i.e., recalled pain is higher than initial report) report more pain and distress at future pain experiences [7,26,31]. These memories are formed early in life and set the stage for how individuals cope with pain and approach/avoid medical care into adulthood [35]. It has recently been shown that children's pain memories may underlie the development of chronic pain. Adolescents who developed more negatively biased recall of post-surgical pain reported higher levels of pain 4 months later, precisely at a time when pain can transition from an acute to a chronic state [31]. Thus, understanding the processes underlying children's pain memory development is clinically important.

It has been said that "memory is not like a tape recorder" [50]. Rather, memory is highly malleable and susceptible to distortion. This is particularly true in early childhood when children's memories are most susceptible to source errors and suggestibility effects [23]. Having a researcher simply provide young children with brief language-based feedback following a needle procedure (i.e., minimizing past pain and telling them that they were brave versus providing neutral feedback) can lead to fewer negative biases in pain memories [2]. However, it is likely that how *parents* reminisce with their children about past painful events has the greatest influence on children's pain memory development. During early childhood, children begin engaging in extended conversations about the past with others [38], and parents play a powerful role in influencing how children understand, appraise, and re-appraise past autobiographical

events, including events involving pain [29]. Indeed, several decades of research in developmental psychology has shown that how parents reminisce with children about emotional events (e.g., injuries, natural disasters) influences the accuracy of children's autobiographical memory development [46]. Parents who are more elaborative (i.e., provide new details) and who refer more to both positive and negative emotions while reminiscing have children who develop more accurate memories [45]. Yet, no studies have investigated the influence of parent-child reminiscing about past *painful* events on the development of biases in children's recall of pain, which have been shown to underlie worse future pain outcomes [30]. Although sex differences in adults' reminiscing have been found [42], research on differences in how mothers versus fathers reminisce with boys versus girls about past emotional events have yielded equivocal findings [3,12]. While prior research has examined mothers' and fathers' verbal behavior *during* child pain [22]—finding no differences—research has not yet examined parent role and sex differences in parent-child *reminiscing* about past painful events and their influence on children's pain memory development.

This prospective study examined the influence of parent-child reminiscing about a recent past surgery in the subsequent development of children's recall of pain. We hypothesized that elements of reminiscing that have been shown to lead to more accurate memories of other emotionally-salient events (elaborative style, emotional content [46]) would be linked to more accurate/positively biased recall of pain. Given the dearth of literature on parent-role and sex differences in reminiscing, we did not have specific hypotheses about how reminiscing would differ based on these individual differences.

Method

This is the third manuscript from this longitudinal study. The first manuscript examined the role of pre-operative anxiety in children's memory biases [11]. The second manuscript examined differences in parent-child reminiscing for sad versus painful autobiographical events (i.e., a tonsillectomy and another painful event) [36]. This second paper was driven by a long tradition in the developmental psychology literature to examine differences in how parents reminisce with young children about different kinds of emotional events. It did not include a follow-up timepoint or assessment of children's recall of pain. Moreover, the aim of this second paper was not to examine reminiscing about a surgery on recall of that surgery and sex and parent role differences in those processes and outcomes. Rather, it was driven by a developmental question about fundamental differences in reminiscing about a variety of autobiographical events. The present paper is the first to examine the predictive roles of parent-child narrative structure and content in the subsequent development of children's pain memory biases. It is also the first to examine differences in reminiscing and recall of pain based on parent role (mothers versus fathers) and child sex (boys versus girls). Methods pertaining to the unique aims of the current study are reported below.

Participants and Setting. Between June 2016 and June 2018, research staff contacted and screened families whose children were scheduled to undergo a tonsillectomy with or without adenoidectomy through the Ear, Nose and Throat Clinic at a tertiary children's hospital in Western Canada. Of the families contacted, 131 participants agreed to participate, 3 families did not complete baseline measures, 4 did not complete ≥ 2 post-surgery questionnaires, 4 dropped out, and 8 were lost to follow-up (see Figure 1). No significant differences were revealed between families who completed versus dropped out from the study (*p*s > .05).

One-hundred and twelve children (60% boys, M_{age} = 5.3 years, *SD* = 1.1) and one of their parents (34% fathers) participated in the study. Children were excluded from the current study if they received pre-medication with anxiolytics (e.g. midazolam), had a developmental disability, a psychiatric diagnosis, or an American Society of Anesthesiology physical status ≥ III. As noted above, 3 parents did not complete the initial questionnaire, 4 parents did not complete at least 2 post-surgical surveys; therefore, these dyads were excluded from the analyses. Data from 112 parent-child dyads, who completed all data points, were included in the analyses. Socio-demographic characteristics of the sample and family medical history are presented in Table 1. Independent samples *t*-tests, chi-square tests, and omnibus tests (ANOVAs) did not reveal any significant differences on key variables based on sociodemographic variables. Ethical approval of the study was obtained from the institutional health research ethics board.

Procedure. Parents were contacted by telephone approximately 1-3 weeks before surgery. If interested and eligible to participate, parents were sent a secure email link to the consent form and the baseline questionnaire through REDCap, a secure online survey web application [13]. In order to participate, parents confirmed that they would be with their children during the post-surgical period and at each of the follow-up time points over the course of 1 month. Assent was obtained from children. On the day of surgery, a standard protocol for anesthesia was followed for each participant. An inhalational induction was employed using sevoflurane, oxygen, and/or nitrous oxide. Following induction, anesthesia was maintained for the procedure with either total intravenous anesthetic (TIVA) or volatile anesthetics. All patients received analgesia of morphine, dexamethasone 0.2 mg/kg IV, and ondansetron 0.1 mg/kg IV during the procedure.

Consistent with previous research [19], on the day of surgery (DOS), parents received hard copies of the faces pain scales with verbal and written instructions on the back to assess

their children's pain intensity and pain-related fear at home on the days following surgery. Parents received daily surveys via REDCap at 5:00 pm on days 1, 2, 3, 7, and 14 post-surgery and indicated their children's report of pain-intensity and pain-related fear for that particular day.

Two weeks post-surgery, families were invited back to the hospital (where the research lab is physically located) for a lab visit. The visit involved a structured narrative elicitation task [44] in which parent-child dyads were instructed to reminisce together about the recent tonsillectomy (i.e., when children first came to the hospital for their surgery and the first few days post-surgery). Consistent with previous research on parent-child reminiscing [43,44], parents and children were instructed by the researcher to talk as normally as possible, and for as long as they wished. During the parent-child narratives, the researcher left the room. Narratives were audio-recorded and transcribed verbatim. Following completion of the lab visit, parents and children received a $20 gift card to thank them for their time.

Approximately one month after surgery, a trained research assistant conducted an established an memory interview [26] with children via telephone using the same faces pain scales previously administered (FPS-R, CFS). Specifically, children recalled their pain intensity and pain-related fear on the day of the surgery (DOS), Day 1 post-surgery, and Days 1-3 post-surgery (i.e., an average pain rating for these 3 days). While parents received instructions to assist their child in looking at the correct scale, they were specifically asked not to prompt their child, in order to facilitate assessment of what their child remembered independently. Each face on the scale corresponded to a randomly chosen letter underneath to avoid confounding a number with a face and to facilitate ease of communication via telephone [26]. Upon completion of the study, participants received a $20 gift card to thank them for their time.

Measures.

Parent measures.

Socio-demographics. Parents reported their own and their child's age, sex, and ethnicity, medical history (i.e., previous surgeries), and preparation for their child's tonsillectomy. Parents also reported their annual household income, education, and employment status.

Child measures.

Pain intensity. The Faces Pain Scale Revised is a recommended self-report measure of children's pain intensity and was used to assess children's post-surgical pain intensity and memory for pain intensity (FPS-R) [14]. The FPS-R is a single-item measure depicting six gender-neutral faces ranging in facial expressions from neutral (0) to extreme pain (10). Children were asked by a researcher (at the hospital) or a parent (at home) to indicate how much they hurt by pointing to a face on the FPS-R. The FPS-R shows evidence of good test-retest reliability and construct validity for children in this age range [48] and has previously been used to assess young children's recall of pain [27].

Pain-related fear. The Children's Fear Scale (CFS) was used to assess children's post-surgical pain-related fear and recall of post-surgical pain-related fear [21]. The CFS comprises five faces displaying varying amounts of fear anchored by 'not at all scared' (0) to 'most scared possible' (4). The CFS has demonstrated good test-retest reliability and construct validity [21] and has previously been used with young children to assess experienced and recalled pain-related fear [27]. In line with a multifaceted approach to measuring children's pain memories [34], both the FPS-R and CFS were utilized to capture the sensory (pain intensity) and affective (pain-related fear) aspects of children's recall of pain.

Narrative coding scheme.

Parent-child narratives from the lab visit were transcribed verbatim, broken into utterances (i.e. sentences), and subsequently coded, based on adapted coding schemes drawn from the developmental psychology literature [44]. Specifically, parent utterances were coded based on structure and content (for a full description of the adapted coding scheme with examples see [36]). Consistent with previous research, proportions of each code type were calculated in relation to the total number of codes, to control for potential differences between dyads and narrative length [44]. Two coders learned the coding scheme by concurrently coding five transcripts. After resolving discrepancies, one coder coded the remaining transcripts. Twenty percent of randomly chosen narratives (22) were coded by both coders to calculate reliability. Inter-rater reliability was calculated using Cohen's kappa and was excellent (i.e., .85 for structure and .82 for content). Proportions of each narrative code type are presented in Table 3.

Narrative structure. Structural narrative coding was drawn from research by Sales and colleagues [44]. First, each parent utterance was coded as either a statement or a question. Then, questions were coded as being open-ended or close-ended (i.e., yes-no questions). Both statements and questions could be further coded as repetitive (i.e., containing old information from the conversation) or elaborative (i.e., containing new information). One-word utterances were coded as evaluations (i.e., *"Yes"* or *"No"*). Child utterances were coded based on whether they contained new information (i.e., elaboration) or if they were a one-word reply (e.g., "*Yes", "No", "I don't know"*). A child's utterance was coded as an off-topic switch if it contained unrelated content to the conversation. No codes were provided for utterances following an off-topic switch.

Narrative content. Research by Sales and Fivush informed the content coding scheme used in the current study [44]. Parent and child utterances were coded based on whether they

contained words that fell into the following content categories: pain, coping, explanation, anxiety/fear, and emotion (negative, neutral, positive). As such, utterances could receive multiple codes (e.g. if being scared was mentioned in an utterance, it would receive two codes: "anxiety/fear" and "negative emotion"). Proportions of each type of content code were calculated in relation to the total amount of content codes.

Data Analyses

Statistical analyses were performed using SPSS v. 24 [15]. Descriptive statistics were conducted to characterize the sample and obtain means and standard deviations of the key variables. Independent samples *t*-tests, chi-square tests, and omnibus tests (ANOVAs) were used to examine SES differences on the key variables, as well as differences between families who completed versus withdrew from the study.

Narrative codes and biased recall of pain. Similar to previous research [26,33], children's initial ratings of pain and pain-related fear (Day of surgery, Day 1 after surgery, and an average of Day 1-3 ratings) were used as covariates in analyses to assess biases in children's recalled pain. Specifically, the initial pain rating that corresponded to the recalled pain rating was entered as a covariate to determine the degree to which recall was biased (e.g., the day of surgery pain intensity rating was entered as a covariate in analyses pertaining to *recalled* day of surgery pain intensity). If pain intensity or pain-related fear ratings for one of the three days (5% of pain intensity, 4% of pain-related fear) were missing, an average of two ratings was used. A series of partial correlations with two-tail hypothesis testing was conducted to first examine the associations between surgery narrative codes and children's recall biases for pain intensity and pain-related fear. Narrative codes that were significantly associated with biases in children's recall of pain were used as predictors in the hierarchical regression analyses. Child age, sex, and

initial ratings of pain intensity and pain-related fear were entered in the first two steps of every model.

Sex and parent role differences. First, to examine differences based on child sex and parent role, MANOVAs were conducted to examine whether parents and children differed in their use of narrative codes. Significant MANOVAs were followed up with independent sample *t*-tests with bonferroni-adjusted alphas. To examine whether the interaction between child sex and parent role influenced parent and child use of narrative codes, factorial ANOVAs were used. Significant factorial ANOVAs were followed up with simple effect tests (ANOVAs) and bonferroni alpha adjustment was applied.

Finally, analyses of covariance (ANCOVAs) were conducted to assess sex and parent role differences in children's memory biases for pain and pain-related fear with initial pain ratings included as covariates.

Results

Descriptive statistics.

Descriptive statistics of the key variables are presented in Table 2.

Medical history and hospital stay. Most children (67%) had not received a previous surgery, whereas 72% of parents had undergone a surgical procedure (40% had a tonsillectomy). Sixty-eight percent of parents sought additional information about the surgery (e.g., searched for information online, attended a Surgery 101 workshop). Most children (62%) presented with an obstructive sleep apnea (OSA) diagnosis. Nearly all participants (98%) received an inhalational anesthesia with sevoflurane (95%). On average, children received 2.5 mg (*SD* = 1.4) of intraoperative morphine. Most children (90%) were extubated deep. All children were admitted to the Pediatric Acute Care Unit (PACU) and stayed for an average of 47.1 minutes (*SD* = 21.3).

While in PACU, 32% of children received morphine (*M* = 1.3 mg, *SD* = 0.9) and 19% received Tylenol (*M* = 387.2 mg, *SD* = 383.5). On average, children reported 2.9/10 (*SD* = 3.4) pain intensity and 0.8/4 pain-related fear (*SD* = 1.3) ratings 2 to 3 hours post-surgery (Day of surgery ratings, DOS). Most children went home the same day of their surgery (72%) and did not have any post-surgery complications (77%). There were no significant differences revealed on any of the key variables (*p*s > .05) between children who went home versus who did not go home on the day of surgery. Moreover, no differences were found between children who did versus who did not experience any post-surgical complications.

Post-surgical and recalled pain and pain-related fear ratings. On Day 1 post-surgery, children reported 3.9/10 (*SD* = 3.2) pain intensity and 0.8/4 (*SD* = 1.3) pain-related fear ratings. On Days 1-3, children reported 3.7/10 (*SD* = 2.4) pain intensity and 0.8/4 (*SD* = 1.0) pain-related fear ratings. One month after the tonsillectomy, children recalled 4.6/10 (*SD* = 3.6) pain intensity and 1.4/4 (*SD* = 1.4) pain-related fear immediately after the surgery, 4.6/10 (*SD* = 3.7) pain intensity and 1.4/4 (*SD* = 1.4) pain-related fear on Day 1 after the surgery, and 4.5/10 (*SD* = 3.7) pain intensity and 1.3/4 (*SD* = 1.4) pain-related fear on Days 1-3 after the surgery.

Narrative codes used during the lab visit and the memory interview. On average, participants completed the narrative elicitation task 16.6 days after the surgery (*SD* = 4.3, *Range* = 9-35 days). During that interim period (i.e., from after the surgery to the time of the narrative elicitation task), parents reported talking about the tonsillectomy a moderate amount (*M* = 4.9/10; *SD* = 2.6, 0 = 'not at all', 10 = 'a lot'). On average, parents produced 78.6 utterances (*SD* = 50.2), and children responded with 45.7 utterances (*SD* = 30.7). The memory interview took place 32 days after the surgery (*SD* = 5.3, *Range* = 25-50 days). Means and standard deviations of narrative codes are presented in Table 3.

Recall biases and narrative codes: correlational analyses.

A series of partial bivariate correlations controlling for initial pain ratings revealed significant associations between narrative codes used by parents and children's recall of pain. Specifically, a higher proportion of statement elaborations (i.e., utterances containing novel information: SE) was associated with more positively biased recall of Days 1-3 pain-related fear (r = -.21, p = .023). Higher levels of overall parent use of elaboration elements (i.e., narrative structure code containing novel information: MQE, YNE, SE) were associated with more positively biased recall of pain-related fear on Day 1 after surgery (r = -.20, p = .038). Conversely, a higher proportion of parent evaluations were associated with more negatively biased recall of DOS pain intensity (r = .20, p = .036) and recalled pain-related fear on Day 1 after surgery (r = .26, p = .006). Other elements of parent reminiscing style and the child narrative codes were not significantly associated with biases in children's recall of pain (ps > .05).

With regard to parent content narrative codes, a higher proportion of words related to positive emotions and emotions in general (i.e., negative, positive, or neutral emotions) was correlated with more positively biased recall of Days 1-3 pain intensity (r = -.21, p = .025; r = -.23, p = .014), respectively. A higher proportion of pain-related words was associated with more negatively biased recall of DOS pain intensity (r = .32, p = .001) and pain-related fear (r = .22, p = .018).

With regard to child content narrative codes, a higher proportion of overall emotion-laden words (i.e., words related to negative, positive, or neutral emotions) was associated with more positively biased recall of pain intensity on Day 1 after surgery (r = -.25, p = .008). More frequent use of explanation-related words was also associated with more positively biased recall

of DOS pain intensity (r = -.21, p = .028). Similar to parent use of pain-related words, a higher proportion of pain-related words was correlated with negatively biased recall of DOS pain intensity (r = .28, p = .003). Other narrative content codes were not significantly associated with biases in children's recall of pain (ps > .05).

Recall biases and narrative codes: hierarchical regression analyses.

In line with previous research [33], the hierarchical models included predictors (narrative codes) and outcomes (recalled pain intensity or recalled pain-related fear) that were significantly correlated. Four hierarchical regression models were conducted to examine the influence of narrative structure (i.e., parent elaboration style) as well as parent and child narrative content on biases in children's recall of pain intensity and pain-related fear. A fifth model examined the influence of multiple narrative codes on biases in children's recall of DOS pain. Child characteristics (age, sex) and initial pain ratings that corresponded to the recall ratings were controlled in the first and second steps of the models, respectively. The results of these analyses are summarized in Table 4.

Model 1. Parent narrative elaboration style and recall of pain-related fear (Days 1-3). Child age, sex, and initial report of pain-related fear (Days 1-3) accounted for 9.6% of the variance in children's recall of pain-related fear (Days 1-3) (F(3, 111) = 3.93, p = .01), with child age and sex accounting for 1.5% (ΔF(2, 112) = 0.87, p > .05) and the initial pain report accounting for 8.1% of the variance (ΔF(1, 111) = 9.92, p < .01). Above and beyond child age, sex, and initial reports of pain-related fear, the proportion of parent statement elaborations (SE) significantly accounted for 3.3% of the variance in children's recall of pain-related fear (Days 1-3) (ΔF(1, 110) = 4.20, p < .05). A negative beta weight suggests that greater use of parent

statement elaborations was related to more *positively* biased memories of pain-related fear (Days 1-3).

Model 2. Parent narrative elaboration style and recall of pain-related fear (Day 1). Child age, sex, and initial report of pain-related fear (Day 1) accounted for 7.4% of the variance in children's recall of pain-related fear (Day 1) ($F(3, 110) = 2.94$, $p < .05$), with age and sex accounting for 4.8% ($\Delta F(2, 111) = 2.82$, $p > .05$) and the initial report accounting for 2.6% of the variance ($\Delta F(1, 110) = 3.08$, $p > .05$). The proportion of parent overall elaborations (MQE, YNE, and SE) accounted an additional 2.2% of the variance in children's recall of pain-related fear (Day 1) ($\Delta F(1, 109) = 2.65$, $p > .05$), while controlling for child sex, age, and initial reports of pain-related fear (Day 1). A negative beta weight suggests that greater parental use of overall elaborations was related to more *positively* biased recall of pain-related fear (Day 1).

Model 3. Parent narrative content and recall of pain intensity (Days 1-3). Child age, sex, and initial report of pain intensity (Days 1-3) accounted for 6% of the variance in children's recall of pain intensity (Days 1-3) ($F(3, 109) = 2.34$, $p > .05$), with age and sex accounting for 0.8% ($\Delta F(2, 110) = 0.42$, $p > .05$) and the initial report accounting for 5.3% of the variance ($\Delta F(1, 109) = 6.14$, $p < .05$). Above and beyond child characteristics and initial reports of pain intensity, the proportion of parent-used words associated with positive emotions significantly accounted for an additional 4.6% of the variance in children's recall of pain intensity (Days 1-3) ($\Delta F(1, 108) = 5.53$, $p < .05$). A negative beta weight suggests that greater parental use of positive emotional language was related to more *positively* biased recall of pain intensity (Days 1-3).

Model 4. Child narrative content and recall of pain intensity (Day 1). Child age, sex, and initial report of pain intensity (Day 1) accounted for 16.1% of the variance in children's recall of pain intensity (Day 1) ($F(3, 107) = 6.85$, $p < .001$), with age and sex accounting for

2.6% ($\Delta F(2, 108) = 1.45$, $p > .05$) and the initial report accounting for 13.5% of the variance ($\Delta F(1, 107) = 17.23$, $p < .001$). The proportion of emotion-laden words used by children additionally accounted for a significant proportion (5.6%) of the variance in children's recall of pain intensity (Day 1) ($\Delta F(1, 106) = 7.54$, $p < .01$). A negative beta weight suggests that greater child use of emotion words was related to more *positively* biased recall of pain intensity (Day 1).

Model 5. Parent and child narrative content and recall of pain intensity (DOS).

Multiple narrative codes (i.e., parent use of evaluations and pain-related words, children's use of pain- and explanation-related words) were significantly related to biases in children's recall of DOS pain and were included as predictors in Model 5. Child age, sex, and initial report of DOS pain accounted for 1.4% of the variance in children's recall of DOS pain ($F(3, 108) = 0.51$, $p > .05$), with age and sex accounting for 1.1% ($\Delta F(2, 109) = 0.62$, $p > .05$) and the initial report of DOS pain intensity accounting for 0.3% of the variance ($\Delta F(1, 108) = 0.30$, $p < .05$). Above and beyond child age, sex, and initial reports of pain intensity, narrative codes significantly accounted for 17.1% of the variance in children's recall of DOS pain intensity ($\Delta F(4, 104) = 5.47$, $p < .001$) with the proportion of parent-used words associated with pain being the only significant narrative code predictor. A positive beta weight suggests that greater parental use of pain words was related to more *negatively* biased recall of pain intensity (DOS).

Parent role and sex differences in narrative codes and recall biases.

Multivariate analyses of variance (MANOVAs) and analyses of covariance (ANCOVAs) did not reveal any significant differences in recall biases or narrative styles between boys and girls (*p*s > .05). Similarly, children of fathers versus mothers did not differ in their recall of pain (*p*s > .05). However, parents significantly differed in their use of narrative codes. Specifically, fathers ($M = .09$, $SD = .07$) used explanations more frequently compared with mothers ($M = .06$,

SD = .06, $t(113) = 2.33$, $p = .021$, $\eta^2 = .044$). Children of fathers (*M* = .14, *SD* = .14) versus mothers (*M* = .09, *SD* = .10) used more words related to negative emotions ($t(111) = 2.51$, $p = .014$, $\eta^2 = .030$).

Further, we performed between-subjects 2 (child sex: boys; girls) x 2 (parent role: mother; father) ANOVAs in order to investigate the effects of child sex and parent role on parent-children use of narrative codes. Parent use of negative emotion words was qualified by a significant interaction between child sex and parent role, $F(1, 114) = 8.18$, $p < .01$, $\eta^2 = .069$. Follow-up *t*-tests revealed that fathers used negative emotion words similarly with boys and girls ($p > .05$), whereas mothers used negative emotion words more frequently with boys (*M* = .13, *SD* = .09) than girls (*M* = .09, *SD* = .06), $t(73.52) = 2.71$, $p < .01$. Children's use of pain-related words was also qualified by a significant interaction between child sex and parent role, $F(1, 113) = 6.73$, $p < .05$, $\eta^2 = .058$. Boys used pain-related words with the same frequency when talking with fathers and mothers ($p < .05$). Girls, however, used more pain-related words when reminiscing with mothers (*M* = .15, *SD* = .15) as compared to fathers (*M* = .06, *SD* = .07), $t(44) = 2.57$, $p < .05$.

Discussion

This study examined the roles of mother- and father-child reminiscing about a past surgery on young children's subsequent pain memory development. Findings revealed that how parents and children talked about this past painful event was related to the development of subsequent biases in children's recall of pain. Parents who used a more elaborative reminiscing style had children who developed more accurate/positively biased recall of pain-related fear. Greater use of emotion-laden words by parents (i.e., positive) and children (i.e., negative, positive, neutral) while reminiscing about the past surgery was related to children developing

more accurate/positively biased recall of pain intensity. Conversely, when parents used more pain-related words while reminiscing about the past surgery, children tended to develop more negatively biased recall of pain. Taken together, these findings underscore the importance of parent-child reminiscing about past painful events in influencing children's subsequent pain memory development and begin to isolate specific narrative elements that are linked to negative biases in children's pain memories.

These findings are in keeping with both the pediatric pain and developmental psychology literatures. Those elements of parent-child reminiscing about a past surgery that were linked to more accurate and positively biased memories for pain have also been shown to be linked to other adaptive developmental outcomes. Indeed, a more elaborative style of reminiscing about past negative emotional events has been shown to be robustly linked to better cognitive (e.g., memory, language), social (e.g., prosociality), and emotional (e.g., emotion regulation) developmental outcomes [17,18,46]. Elaborative reminiscing style creates coherent, story-like narratives and elucidates causal relationships associated with the past event [37]. Reminiscing about past emotions, including negative emotions, enhances children's emotion knowledge and understanding, which, in turn, may lead to better self- and emotion-regulation skills [16,18]. The current findings extend this literature by demonstrating that parent-child reminiscing about a past painful experience is also linked to the development of more adaptive (i.e., more accurate or positively biased) pain memories. The finding that greater parental use of pain words while reminiscing about the past surgery was linked to more negatively biased recall of pain is also in line with previous research on acute pediatric pain. Several empirical studies have shown that parents who attend more to pain while talking to children immediately before and during acutely painful experiences (needle procedures, experimentally-induced pain) have children who

experience greater immediate pain and distress [4,5,20,51]. This is likely due to the fact that drawing children's attention to pain heightens their somatic sensations, threat perception, and bodily vigilance [51]. Our findings extend this research by showing that a linguistic emphasis on the sensory and affective aspects pain while reminiscing about a past painful experience, has a long-lasting influence on the development of children's memories for pain.

Although boys and girls did not differ in terms of recall biases, reminiscing differed between mother- and father-child dyads. Fathers used more explanations when reminiscing with their children than mothers. Additionally, children of fathers, but not mothers, used more words related to negative emotions. Mothers, but not fathers, used more negative emotion words when talking with boys versus girls. Moreover, girls, but not boys, used more pain-related words when reminiscing with mothers versus fathers. While these results are preliminary and the narrative codes that did differ were not related to recall biases for pain, children of parents who use more explanations and refer more to emotions while reminiscing have been shown to have better developmental outcomes (e.g., emotional understanding, accurate memories) [46]. Research should examine other future pain, health, and developmental outcomes to gain a greater understanding of the degree to which these narrative differences are clinically significant and may be a pathway for the socialization of pain behaviors. It has been argued that the potential novelty of talking to fathers about past autobiographical events and greater attempts to be engaging with them may translate into children using more emotion-laden words with their fathers versus mothers [1,41]. Moreover, when talking to young children, fathers have been shown to focus relatively more on *what* happened versus the emotional content of the event [12], which could account for why fathers explained more to children while reminiscing than mothers did. Further investigations of parent role and sex differences in reminiscing using more advanced

statistical analyses (e.g., dyadic, sequential, and contingency responding analyses) and additional longitudinal outcomes are warranted. In particular, future research should employ time-window sequential analysis [8] to examine the bidirectional relationships between parent and child utterances as well as the interactions between them in influencing outcomes (including memory and pain).

From a clinical perspective, we do not believe that this research suggests that parents should not reminisce with their children about pain. Rather, it points to *how* parents may most adaptively reminisce about past painful experiences to potentially buffer against children developing negatively biased pain memories. By using an elaborative reminiscing style, parents engage their children in a rich discussion about their past experience, filling in new details, encouraging and fostering a *coherent* narrative about this past experience, and also co-constructing the *meaning* of that experience. Moreover, talking about painful experiences need not over focus on the sensory and affective aspects of pain itself but rather emphasize other aspects of the overall experience. The current findings suggest that *how* parents reminisce (e.g., using an elaborative reminiscing style) and *what* parents talk about (e.g., using words related to positive emotions and pain) with their children is what is predictive of biases in children's pain memories. Given the malleability of memory, particularly during early childhood [29], and the pivotal role of parental reminiscing on children's cognitive development during this period of development [24], this is likely an ideal time to intervene [25]. Even among high risk samples of parents (e.g., low SES), interventions to teach parents how to more elaboratively reminisce with their children about past autobiographical events have been efficacious in fostering better developmental (including cognitive) outcomes [46]. Moreover, parents have been effectively trained to use less pain-attending language with their children *during* acute experimental pain to

improve immediate pain outcomes [5,52]. Thus, it is likely that parents could be effectively taught how to reminisce with their children in ways informed by this study (e.g., more elaborative style, less pain words, more references to positive emotions) to foster more adaptive pain memory development; however, such a trial has not yet been conducted. Furthermore, while the current study focused on *parents'* reminiscing style, we think that this work also has relevance to other adults in children's lives, including their health care providers. Indeed, past research that has examined memory reframing interventions involving talking to children in a particular way about their past painful procedures has employed adult researchers reminiscing with children about painful experiences prior to imminent needle procedures [28]. Health care professionals could reminisce with children about past procedural experiences prior to procedures in ways that are elaborative, de-emphasizing details specific to pain sensations, and pulling for information that involved positive emotions (e.g., a friendly nurse, helpful strategies used, getting a treat afterwards, etc.). This is an important area for future research.

The clinical significance of the findings is supported by previous research linking similar/any deviations in children's memories for pain to ratings of distress and pain during future pain experiences. This has been demonstrated across populations (cancer, healthy) and pain contexts (needles, surgeries) which supports the clinical significance and robustness of these findings [7,26,33]. The current study did not examine outcomes beyond assessment of children's recall, therefore, we draw information about the clinical significance of the current findings and operational definitions from past research relating memory biases of similar magnitude to pain, fear and distress at subsequent pain experiences. Among healthy 8-12-year-old children undergoing cold pressor pain and adolescents undergoing surgeries like pectus repair and spinal fusion, the effect sizes for the relationships between memory biases and subsequent pain and fear

were moderate to high (i.e., correlation coefficients within the range of 0.2 - 0.6 [26,33]). In more complex regression models that controlled for child age and sex, initial pain ratings, anxiety, children's memories for cold pressor pain explained 15% of variance in subsequent pain report [26]. Finally, a medium effect size (b= .419; ß=.415) has been found for the relationship between children's memories for postsurgical pain on future pain 4 months post-surgery [32]. We believe that the findings of the current study lay the foundation for the development of clear and easily developed interventions to target parent-child reminiscing to foster more accurate and positively estimated memories for pain. Based on previous trials of memory reframing interventions for needle pain [6,39], that have found moderate effect sizes for the impact of the intervention on recall, we would hypothesize similar effect sizes. However, to empirically demonstrate this, it is necessary for future research to build upon this detailed observational work and conduct a controlled trial to determine the impact of parent-child reminiscing on children's recall of pain.

This study had limitations and underscores several areas for future research. First, this study did not capture nonverbal information or the affective tone used during parent-child reminiscing about past pain. Research suggests that the positive or negative influence/interpretation of a specific use of language (e.g., reassurance) in the context of acutely painful procedures may be dependent on parental tone of voice and facial expression [20]. Future research should apply a broader assessment of verbal and non-verbal information in the narratives. Additionally, we acknowledge the uniqueness of this type of surgery and the potential lack of generalizability to other types of acutely painful procedures. Tonsillectomies occur at only one point in a child's life and therefore are both novel and salient, two factors that influence memory consolidation and recall [47]. While from a methodological perspective, this is optimal

because recall of pain can more reliably be tied to a specific time and place, it is unknown how parent-child reminiscing and its influence on children's memories would differ for repeated painful events (e.g., vaccine injections). Indeed, the accuracy of children's recall has been shown to differ for single versus repeated autobiographical events [40]. Further, parent-child dyads reminisced about the entire post-surgical experience, which lasted over the span of several days and included many aspects (e.g., relatives and friends visiting, not going to school, disruptions to their usual routine) in addition to the experience of pain. Repeated painful events (e.g., vaccine injections) are shorter, occur every year or more frequently, and are more centered around the pain and fear experience. Further, despite active advocacy efforts, pain management during needle procedures is often inadequate [49], whereas following surgery (i.e., during the in-hospital stay and the first 24 hours post-discharge), the majority of children receive pharmacological and/or non-pharmacological pain management [10]. Examining the influence of parent-child reminiscing about repeated painful events and its role in the development of children's pain memories and future pain experience is a key avenue for future research. Research is needed to understand how the tonsillectomy experience generalizes to other clinical pain contexts.

While the current findings show that an elaborative reminiscing style was linked to adaptive (i.e., less negatively biased) memories, it could be argued that elaboration, and specifically the tendency to introduce new content to the conversation, could be construed as a tendency to avoid further discussion about a particular topic. We have demonstrated that parents tend to employ elaboration more frequently when talking about past sad events versus painful events and have argued that one potential reason for this could be parental tendencies to avoid an uncomfortable, or potentially triggering topic of past pain [36]. Previous work has shown that in

analyzing parent-child conversations that mentioning pain, an overwhelming majority were about *present* pain or *future/imaginary* pain. Only 2% of parent-child dyads talked about past pain experiences [9]. Further work is needed to test this hypothesis and we believe this line of inquiry could be enriched by incorporating sociological and cultural perspectives. In addition, dispositional characteristics may influence parent-child reminiscing about painful events. In previous research with adolescents undergoing major surgeries, higher parent catastrophizing about child pain was found to be related to more negatively-biased post-operative pain memories [33], and it is possible that parent-child interactions underlie this relationship. There may be other factors that may influence parent-child reminiscing about pain and recall biases, particularly in *younger children*. For example, the nature of the parent-child attachment relationship, the parents' own memories and experiences with similar types of pain, and more generally, parenting stress may all play a role. This is a key area for future research. Moroever, parents' memories of their own past surgeries were not assessed and could have influenced parent-child reminiscing and children's recall. In addition, the current sample was predominantly white, which precluded examination of cultural differences in reminiscing; however, this is an important avenue for future research. Finally, developmental studies [1,41] have strived to include both parents of each child as reminiscing partners. Due to feasibility issues, we did not examine within-family differences in reminiscing, therefore, influences of either parent on their child's memory biases cannot be determined.

In conclusion, this study examined the influences of parent-child reminiscing about a past surgery on children's subsequent pain memory development. A more elaborative parental reminiscing style and more references to positive emotions in the narratives were linked to more accurate and positively biased recall of pain. Conversely, greater parental use of pain-related

words was related to more negatively biased recall of pain. Although parent role and sex differences in children's pain memory biases were not found, several differences in reminiscing emerged. Fathers reminisced in ways (more negative emotions, more explanations) that have been previously linked to more adaptive developmental outcomes. Moreover, mothers used more negative emotional language with boys and girls used more pain-related words when reminiscing with mothers. By isolating specific elements of parent-child reminiscing that are linked to biases in children's recall of pain, which are robust predictors of future pain experience [7,26,31], this work can inform the development of parent-led interventions to reframe children's memories for pain to be more accurate and positive.

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Table 1. Sociodemographic characteristics and medical history of the sample.

Child Age (years)	***M***	***SD***
	5.33	1.10
	Frequency (%)	
Child Sex (female)		40
Parent Role (mother)		66
Parent Ethnicity		
Aboriginal		1
Arab/West Asian		4
Filipino		3
South Asian		3
South East Asian		1
White (Caucasian)		77
Two or more ethnicities		6
Did not answer		5
Child Ethnicity		
Arab/West Asian		4
Filipino		3
South Asian		3
South East Asian		1
White (Caucasian)		72
Two or more ethnicities		12
Did not answer		5
Annual Household Income (>$70,000)		78
Employment		
Full-time		55
Part-time		20
Unemployed		25
Parent Education		
High school or less		11
Vocational school/some college		24
College/Bachelor's degree		49
Graduate degree (MSc/PhD)		16
Marital Status		
Married		79
Single		8
Common-law		9
Separated/divorced		4
Parent had a tonsillectomy		40

Child had a surgery	33
Parent accessed information about tonsillectomy	68
Children's presenting diagnosis	
Obstructive sleep apnea	62
Tonsillitis	12
Other	26

Table 2. Descriptive data for key variables (*N* = 112).

Variable	***M***	***SD***
Initial ratings of pain and pain-related fear		
Pain intensity (DOS)	2.89	3.44
Pain-related fear (DOS)	0.78	1.32
Pain intensity (Day 1)	3.88	3.20
Pain-related fear (Day 1)	0.84	1.26
Pain intensity (Days 1-3)	3.70	2.40
Pain-related fear (Days 1-3)	0.81	0.98
Recalled levels of pain and pain-related fear		
Pain intensity (DOS)	4.58	3.64
Pain-related fear (DOS)	1.41	1.39
Pain intensity (Day 1)	4.58	3.74
Pain-related fear (Day 1)	1.36	1.42
Pain intensity (Days 1-3)	4.51	3.65
Pain-related fear (Days 1-3)	1.33	1.38

Note. DOS: Day of surgery.

Table 3. Means and standard deviations for proportions of parent and child narrative codes.

Utterance code type	***M***	***SD***

Parent Structure		
Memory Question Elaboration (MQE)	.06	.05
Yes-no Question Elaboration (YNE)	.27	.10
Statement Elaboration (SE)	.14	.10
Memory Question Repetition (MQR)	.10	.06
Yes-no Question Repetition (YNR)	.23	.09
Statement Repetition (SR)	.05	.04
Evaluation (EVAL)	.15	.08
Child Structure		
Memory Elaboration (ME)	.41	.16
Memory Placeholder (MP)	.50	.17
Off-topic Switch (OTS)	.09	.10
Parent Content		
Positive Emotion (PEP)	.12	.09
Negative Emotion (PEN)	.12	.08
Neutral Emotion (PE_)	.09	.07
Total Emotions (PEMS)	.34	.13
Explanation (PEX)	.07	.06
Coping (PCP)	.05	.06
Pain (PPN)	.12	.07
Child Content		
Positive Emotion (CEP)	.17	.20
Negative Emotion (CEN)	.11	.12
Neutral Emotion (CE_)	.09	.15
Total Emotions (CEMS)	.34	.21
Explanation (CEX)	.16	.17
Coping (CCP)	.03	.08
Pain (CPN)	.12	.13

Table 4. Hierarchical regression models (*N* = 112).

Criterion Variable	Step	Predictor	β	ΔR^2	Cumulative R^2
Memory for pain-related fear (Days 1-3)	1	Child age	-.11	.015	.015
		Child sex	-.06		
	2	Pain-related fear (Days 1-3)	.29**	.081**	.096*
	3	Parent statement elaborations	-.19*	.033*	.129**
Memory for pain-related fear (Day 1)	1	Child age	-.12	.048	.048
		Child sex	.18		
	2	Pain-related fear (Day 1)	.16	.026	.074*
	3	Parent total elaborations	-.16	.022	.096*
Memory for pain intensity (Days 1-3)	1	Child age	-.09	.008	.008
		Child sex	-.01		
	2	Pain intensity (Days 1-3)	.23*	.053*	.060
	3	Parent positive emotion words	-.22*	.046*	.106*
Memory for pain intensity (Day 1)	1	Child age	.16	.026	.026
		Child sex	-.02		
	2	Pain intensity (Day 1)	.37***	.135***	.161***
	3	Child emotion words	-.24**	.056**	.217***
Memory for pain intensity (DOS)	1	Child age	.08	.011	.011
		Child sex	.08		
	2	Pain intensity (DOS)	.05	.003	.014
	3	Parent evaluations	.16	.171***	.185**
		Parent pain words	.22*		
		Child pain words	.17		
		Child explanations	-.12		

*$p < 0.05$, **$p < 0.01$, ***$p < .001$